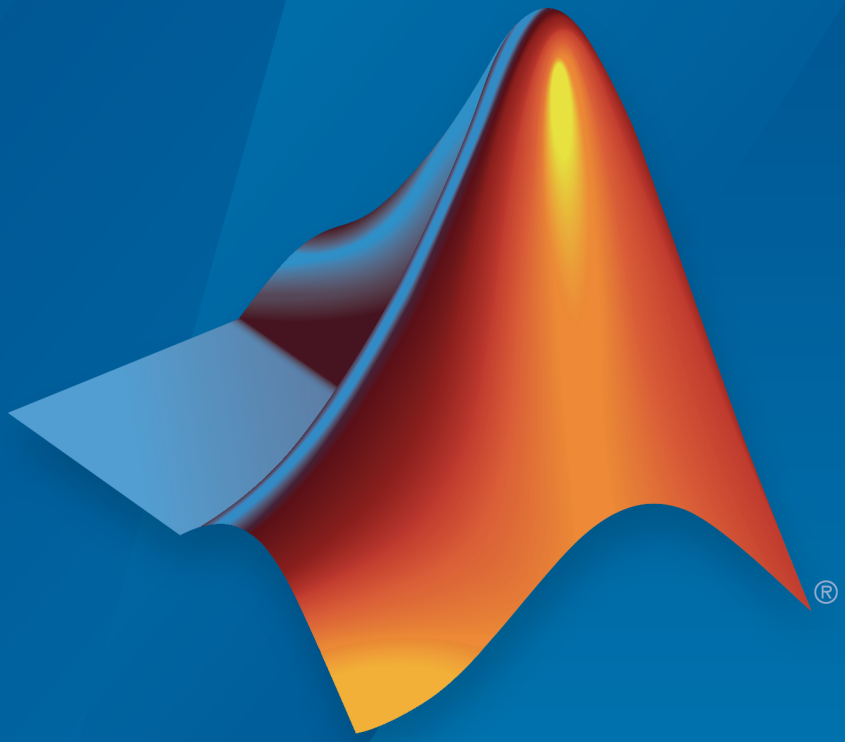
DO Qualification Kit

User's Guide



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DO Qualification Kit User's Guide

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Revision History

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October 2014	Online only	Revised for Version 2.4 (Applies to Release 2014b)
March 2015	Online only	Revised for Version 2.5 (Applies to Release 2015a)

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DO Qualification Kit Product Description

Qualify Simulink and Polyspace verification tools for DO-178 and DO-278

DO Qualification Kit provides documentation, test cases, and procedures that let you qualify Simulink® and Polyspace® software verification tools for projects based on DO-178C, DO-278A, and related supplements. The kit contains tool qualification plans, tool operational requirements, and other materials required for qualifying software verification tools. With the kit, you can streamline certification of embedded systems developed using supported Simulink and Polyspace products.

Tool qualification kits are available for specific versions of Simulink and Polyspace verification tools based on DO-330, Software Tool Qualification Considerations. You can modify the artifacts in the tool qualification kit for your specific project and include them in the DO-178C and DO-278A certification packages submitted for certification.

Key Features

- Tool Qualification Plan and Tool Operational Requirements documents
- Test case models and code, test procedures, and expected results
- Traceability matrix generation covering requirements, models, and generated code
- Qualification materials for Simulink verification, validation, and test tools
- Qualification materials for Polyspace code verification tools
- Artifacts explorer for navigating and viewing artifacts for each supported product
- Checks for tool-associated bug reports

What Is Software Tool Qualification for DO-178C and DO-278A?

Software that is included in avionic systems must be certified by meeting objectives of the DO-178C standard. Software that is included in ground- or space-based systems must be approved by meeting objectives of the DO-278A standard. Both of these standards reference DO-330 as the means to qualify software tools. To achieve credit for the use of a tool in the certification of an avionic system or approval of a ground- or space-based system, you must qualify that tool if the output of the tool is not verified. The DO Qualification Kit product provides resources for qualifying MathWorks® software verification tools. The tool user (not the tool vendor) is responsible for the qualification.

For guidance on how to use the DO Qualification Kit product to qualify MathWorks software verification tools, see “Qualification Process” on page 2-2.

For information on criteria used to determine whether a tool needs to be qualified, and the determination of the tool qualification level, see the “Requirement for Qualification” section of the Tool Qualification Plan for the relevant MathWorks verification tool.

Can You Apply the DO Qualification Kit Product to Other DO Standards?

DO-254

You can use the DO Qualification Kit product to qualify verification tools for projects that follow DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*. The process for tool qualification is described in Section 11.4 of DO-254. The following verification tool capabilities are applicable to DO-254 projects:

- Simulink Verification and Validation™ — DO-178C/DO-331 checks
- Simulink Verification and Validation — Model coverage
- Simulink Report Generator™ — System Design Description report
- SystemTest™ — Limit Check element

To take credit for DO-254 for the verification tool capabilities that are applicable to your project, modify references to DO-178C to refer to the applicable sections of DO-254. For example, modify references to DO-178C Section 12.2 to refer to DO-254 Section 11.4. The following tables list the items to modify and what files correspond to these items.

Simulink Verification and Validation Verification Tool

Item to Modify	File

Document templates	`qualkitdo_slvnv_tqp.docx`
	`qualkitdo_slvnv_tor.docx`
	`qualkitdo_slvnv_tcpr.docx`

Test cases, procedures, and results	`qualkitdo_slvnv_tcpr1.xls*`
	`qualkitdo_slvnv_tcpr2.xls`
	`qualkitdo_slvnv_tcpr3.xls`
	`qualkitdo_slvnv_tcpr4.xls`
	`qualkitdo_slvnv_tcpr5.xls`
	`qualkitdo_slvnv_tcpr6.xls`

*The Model Advisor checks **Check safety-related optimization settings** and **Check safety-related code generation settings** are not applicable to DO-254. In `qualkitdo_slvnv_tcpr1.xls`, delete the rows corresponding to these checks. After deleting the rows, when you generate the report using `qualkitdo_slvnv_tcpr1.rpt`, the report does not include these two checks. Therefore, the report you generate does not match the example report `qualkitdo_slvnv_qualificationreport1.html`.	

Simulink Report Generator Verification Tool

Item to Modify	File

Document templates	`qualkitdo_rptgenext_tqp.docx`
	`qualkitdo_rptgenext_tor.docx`
	`qualkitdo_rptgenext_tcpr.docx`

SystemTest Verification Tool

Item to Modify	File

Document templates	`qualkitdo_systemtest_tqp.docx`
	`qualkitdo_systemtest_tor.docx`
	`qualkitdo_systemtest_tcpr.docx`

Test cases, procedures, and results	`qualkitdo_systemtest_tcpr.test`

Access Model-Based Design Workflow for DO-178C

The DO-178C software life cycle consists of objectives that must be met for each of the life cycle stages. In Annex A of DO-178C, these objectives are summarized in tables. The *DO Qualification Kit Model-Based Design Workflow for DO-178C* document summarizes those tables and provides recommendations on meeting the objectives using a Model-Based Design process.

Open the Artifacts Explorer to access the workflow document. Alternatively, on the MATLAB® command line, type `qualkitdo`. The workflow document is located in **Supporting Artifacts**.

The following table lists available workflow documents.

Workflow Document	File
Model-Based Design Workflow for DO-178C	`qualkitdo_workflow.pdf`

Access Plan for Software Aspects of Certification (PSAC) template

The DO Qualification Kit provides a *Plan for Software Aspects of Certification (PSAC)* template that you can use when qualifying your project. The PSAC provides the planning data defined in DO-178C, Section 11.1.

Open the Artifacts Explorer to access the template. Alternatively, on the MATLAB command line, type `qualkitdo`. The PSAC template is located in **Supporting Artifacts**.

Template	File
Plan for Software Aspects of Certification (PSAC)	`qualkitdo_psac.docx` `qualkitdo_psac.pdf`

Access Software Model Standard (SWMS) template

The DO Qualification Kit provides a *Software Model Standard (SWMS)* template that you can use when qualifying your project. The SWMS is part of the Software Development Plan (SDP). As specified in DO-331 MB.11.23, the SWMS defines the modeling techniques for each type of model.

Open the Artifacts Explorer to access the template. Alternatively, on the MATLAB command line, type `qualkitdo`. The SWMS template is located in **Supporting Artifacts**.

Template	File
Software Model Standard (SWMS)	`qualkitdo_swms.docx` `qualkitdo_swms.pdf`

Supported MathWorks Software Verification Tools

The DO Qualification Kit product includes document templates, test cases, and test procedures that you need to qualify the following MathWorks software verification tools:

- Simulink Verification and Validation (DO-178C/DO-331 checks; model coverage)
- Simulink Report Generator (System Design Description report)
- Simulink Code Inspector™ (Code inspector report)
- Polyspace Bug Finder™
- Polyspace Code Prover™
- SystemTest (Limit Check element)

Note: By qualifying the model coverage capability of the Simulink Verification and Validation product, you can claim credit for demonstrating completeness and adequacy of the test cases generated by Simulink Design Verifier™. Use the model coverage capability instead of reviewing the Simulink Design Verifier report. You can demonstrate completeness and adequacy by running the generated test cases against the model, measuring the model coverage, and reviewing the model coverage report. You can run the test cases on the executable object code and compare the actual results to the simulation results. The model coverage capability does not assess the adequacy of the simulation results, only the test case coverage of the model. Therefore, you must verify that the expected results from the model are acceptable.

In addition to this documentation, the DO Qualification Kit product consists of the qualification documents described in the following sections. The qualification documents are located in your MATLAB installation folder at *`matlabroot`*`/toolbox/qualkits/do`. Although the kit contains the documents and tests that you need to qualify the supported tools, you must determine how to apply the documents and tests to your specific project or application.

Refer to the `PDF` version of a qualification document to become familiar with the qualification process and the required content. To customize the qualification documents for your specific project or application, modify the `DOCX` versions.

Access Qualification Documents for Simulink Verification and Validation

The DO Qualification Kit product supports qualifying the following versions and features of the Simulink Verification and Validation verification tool:

- Version 3.9 (R2015a): DO-178C/DO-331 checks
- Version 3.9 (R2015a): Model coverage

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **Simulink Verification and Validation** > **r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Tool Qualification Plan (TQP)	`qualkitdo_slvnv_tqp.pdf` `qualkitdo_slvnv_tqp.docx`

Tool Operational Requirements (TOR) and supporting documentation	`qualkitdo_slvnv_tor.pdf`
	`qualkitdo_slvnv_tor.docx`
	`qualkitdo_slvnv_ma_ui.pdf`
	`qualkitdo_slvnv_mc_ui.pdf`

Test Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_slvnv_tcpr.pdf`
	`qualkitdo_slvnv_tcpr.docx`
	`qualkitdo_slvnv_tcpr*.rpt`
	`qualkitdo_slvnv_tcpr*.xls`
	`tests/`
	` *.slx`
	` *.m`
	` *.mat`
	`outputs/`
	` qualkitdo_slvnv_qualificationreport*.html`

Access Qualification Documents for Simulink Report Generator

The DO Qualification Kit product supports qualifying the following version and feature of the Simulink Report Generator verification tool:
Version 4.1 (R2015a): System Design Description report

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **Simulink Report Generator** > **r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Tool Qualification Plan (TQP)	`qualkitdo_rptgenext_tqp.pdf` `qualkitdo_rptgenext_tqp.docx`

Tool Operational Requirements (TOR) and supporting documentation	`qualkitdo_rptgenext_tor.pdf`
	`qualkitdo_rptgenext_tor.docx`
	`qualkitdo_rptgenext_sdd_ui.pdf`

Test Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_rptgenext_tcpr.pdf`
	`qualkitdo_rptgenext_tcpr.docx`
	`qualkitdo_rptgenext_tcpr.rpt`
	`tests/`
	` *.slx`
	` *.m`
	` *.mat`
	`outputs/`
	` qualkitdo_rptgenext_qualificationreport_for_*.pdf`
	` qualkitdo_rptgenext_qualificationreport_*.html`
	` qualkitdo_rptgenext_qualificationreport_*.doc`
	` qualkitdo_rptgenext_qualificationreport_*.pdf`
	` qualkitdo_rptgenext_qualificationreport_*.rtf`

Access Qualification Documents for Simulink Code Inspector

The DO Qualification Kit product supports qualifying the following version and feature of the Simulink Code Inspector verification tool:
Version 2.3 (R2015a): Code inspection report

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **Simulink Code Inspector > r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Tool Qualification Plan (TQP)	`qualkitdo_slci_tqp.pdf` `qualkitdo_slci_tqp.docx`

Tool Operational Requirements (TOR) and supporting documentation	`qualkitdo_slci_tor.pdf`
	`qualkitdo_slci_tor.docx`
	`qualkitdo_slci_tr_ref_trace.xlsx`
	`qualkitdo_slci_tr.pdf`
	`slci_ug.pdf`
	`slci_ref.pdf`

Test Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_slci_tcpr.pdf`
	`qualkitdo_slci_tcpr.docx`
	`qualkitdoSlciRunTests.m`
	`qualkitdoSlciRunTests.rpt`
	`qualkitdoSlciRunTests.xlsx`
	`tests/`
	` *.slx`
	` *.m`
	` *.mat`
	`outputs/`
	` qualkitdoSlciQualificationReport_*.html`

Access Qualification Documents for Polyspace Bug Finder

The DO Qualification Kit product supports qualifying the following version and feature of the Polyspace Bug Finder product:
Version 1.3 (R2015a)

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **Polyspace Bug Finder > r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Tool Qualification Plan (TQP)	`qualkitdo_bugfinder_tqp.pdf` `qualkitdo_bugfinder_tqp.docx`

Tool Operational Requirements (TOR)	`qualkitdo_bugfinder_tor.pdf`
	`qualkitdo_bugfinder_tor.docx`
	`qualkitdo_bugfinder_HLR_OR_LSR_trace.xlsx`

Tests Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_bugfinder_tcpr.pdf`
	`qualkitdo_bugfinder_tcpr.docx`
	`Matrix_*.txt`
	`tests/qualkitdo_bugfinder_tcpr.*`
	`outputs/`
	` qualkitdo_polyspace_qualificationreport_*.txt`
	` qualkitdo_polyspace_qualificationreport_summary.pdf`

Access Qualification Documents for Polyspace Code Prover

The DO Qualification Kit product supports qualifying the following version and feature of the Polyspace Code Prover product:
Version 9.3 (R2015a)

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **Polyspace Code Prover > r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Theoretical Foundation (TF)	`qualkitdo_codeprover_tf.pdf` `qualkitdo_codeprover_tf.docx`
Tool Qualification Plan (TQP)	`qualkitdo_codeprover_tqp.pdf` `qualkitdo_codeprover_tqp.docx`

Tool Operational Requirements (TOR) and supporting documentation	`qualkitdo_codeprover_tor.pdf`
	`qualkitdo_codeprover_tor.docx`
	`qualkitdo_codeprover_HLR_OR_LSR_trace.xlsx`
	`codeprover_limitations.pdf`

Tests Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_codeprover_tcpr.pdf`
	`qualkitdo_codeprover_tcpr.docx`
	`Matrix_*.txt`
	`tests/qualkitdo_codeprover_tcpr.*`
	`outputs/`
	` qualkitdo_polyspace_qualificationreport_*.txt`
	` qualkitdo_polyspace_qualificationreport_summary.pdf`

Access Qualification Documents for SystemTest

The DO Qualification Kit product supports qualifying the following version and feature of the SystemTest verification tool:
Version 2.6.9 (R2015a): Limit Check element

Open the Artifacts Explorer to access the document templates, test cases, and test procedures. Alternatively, on the MATLAB command line, type `qualkitdo`. The documents are located in **SystemTest > r2015a**.

The following table lists qualification documents, and the primary files associated with the qualification documents.

Qualification Documents	Files
Tool Qualification Plan (TQP)	`qualkitdo_systemtest_tqp.pdf` `qualkitdo_systemtest_tqp.docx`

Tool Operational Requirements (TOR) and supporting documentation	`qualkitdo_systemtest_tor.pdf`
	`qualkitdo_systemtest_tor.docx`
	`qualkitdo_systemtest_lc_ui.pdf`

Test Cases, Procedures, and Results (TCPR), and supporting documentation	`qualkitdo_systemtest_tcpr.pdf`
	`qualkitdo_systemtest_tcpr.docx`
	`qualkitdo_systemtest_tcpr.test`
	`outputs/qualkitdo_systemtest_tcpr_report/ qualkitdo_systemtest_qualificationreport.html`

What Certification Credit Can Be Achieved?

For a list of areas of the DO-178C standard for which some certification credit (meet or replace DO-178C objectives) can be achieved by qualifying MathWorks verification tools, see the “Certification Credit” section of the Tool Qualification Plan for the relevant tool. The amount of credit that can be achieved is dependent upon the development processes used and how verification tools are applied within the processes.

Required Knowledge

Before using the DO Qualification Kit product, make sure that you have:

- Knowledge about developing safety-critical software.
- Knowledge of:
  - DO-178C, Software Considerations in Airborne Systems and Equipment Certification
  - DO-330, Software Tool Qualification Considerations
  - DO-331, Model-Based Development and Verification Supplement to DO-178C and DO-278A
  - DO-333, Formal Methods Supplement to DO-178C and DO-278A
  - DO-254, Design Assurance Guidance for Airborne Electronic Hardware
- Experience using features of MathWorks verification tools that you want to qualify (and related required software, such as MATLAB and Simulink).

Also, become familiar with the following information:

- “High-Integrity System Modeling” in the Simulink documentation.
- If you have an Embedded Coder® license, “DO-178C Standard” in the Embedded Coder documentation.

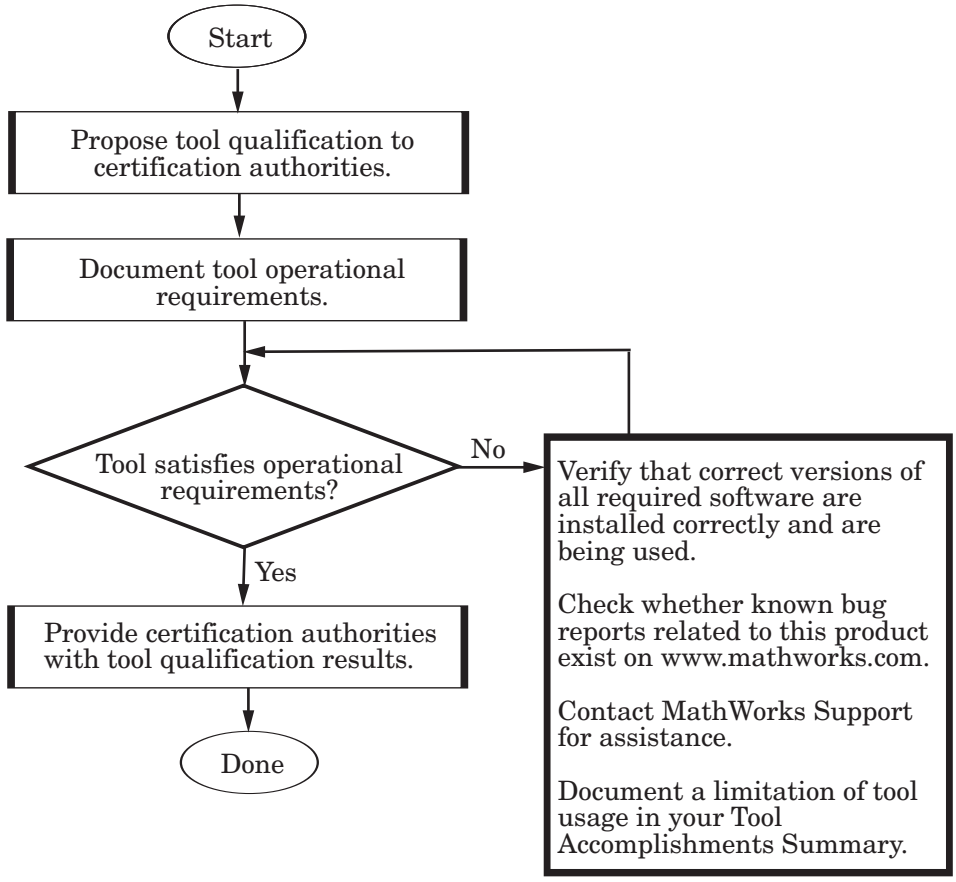
2

Tool Qualification

- "Qualification Process" on page 2-2
- "Propose Tool Qualification Plan to Certification Authorities" on page 2-4
- "Document Tool Operational Requirements" on page 2-6
- "Verify That the Tool Satisfies Tool Operational Requirements" on page 2-7
- "Provide Certification Authorities with Tool Qualification Results" on page 2-9

Qualification Process

1. Provide certification authorities with a tool qualification plan.
2. Document tool operational requirements.
3. Verify that the tool satisfies tool operational requirements and define limitations and restrictions of the tool.
4. Provide certification authorities with tool qualification results, including limitations and restrictions.


Start
Propose tool qualification to certification authorities.
Document tool operational requirements.
Tool satisfies operational requirements?
No
Yes
Verify that correct versions of all required software are installed correctly and are being used.
Check whether known bug reports related to this product exist on www.mathworks.com.
Contact MathWorks Support for assistance.
Document a limitation of tool usage in your Tool Accomplishments Summary.
Provide certification authorities with tool qualification results.
Done

Note: The `rights.txt` file, located at *`matlabroot`*`/toolbox/qualkits/do`, describes allowed uses of the MathWorks DO Qualification Kit product.

Propose Tool Qualification Plan to Certification Authorities

The first step of the qualification process is to propose a Tool Qualification Plan to the DO-178C certification authorities. The Tool Qualification Plan provides the following information:

- Introduction
- Title and version of the Tool Operational Requirements (TOR)
- Certification considerations — basis for qualifying the tool and objectives for which you are seeking certification credit
- Tool development life cycle — planning, requirement documents and activity, verification documents and activity
- Tool life cycle data — mapping of application documents to the DO-178C process life cycle
- Qualification schedule

To propose a Tool Qualification Plan, complete the following steps for each tool that you plan to qualify:

1. Identify a MathWorks software verification tool that you plan to qualify.
2. Locate the PDF version of the Tool Qualification Plan document provided for the tool in the DO Qualification Kit product. Review the document for applicability to your project.
3. Locate and make a copy of the `.docx` Tool Qualification Plan template file for that tool.
4. Edit the template, as required for your application, and make the document available for review. This typically includes adding the following information:
    - In the table located in “Tool Life Cycle Data”, where indicated, references to the documents:
        - Plan for Software Aspects of Certification (PSAC)
        - Software Accomplishment Summary (SAS)
        - Tool Accomplishment Summary (TAS)
    - Tool qualification schedule located in a section titled “Schedule”
5. Add a reference to the tool that you are qualifying and justification why the tool requires qualification to the application PSAC, indicating your intent to use the

verification tool. The DO Qualification Kit provides a PSAC template. See“Access Plan for Software Aspects of Certification (PSAC) template” on page 1-7.

6 Submit the PSAC to the certification authorities. If you want, you can also submit the Tool Qualification Plan with the PSAC. These documents inform the certification authorities of your intent to use a tool and initiates a dialog regarding your plans for certification.

After you complete this procedure, document the Tool Operational Requirements, as described in “Document Tool Operational Requirements” on page 2-6.

Document Tool Operational Requirements

After you propose a Tool Qualification Plan to certification authorities, develop a Tool Operational Requirements document. The Tool Operational Requirements document provides the following information:

- Introduction
- Operational requirements — description of the functionality of the tool and how it is used
- Installation information
- Operational environment

To develop a Tool Operational Requirements document, complete the following steps for each tool that you plan to qualify:

1. Locate the PDF version of the Tool Operational Requirements document provided for the tool in the DO Qualification Kit product, and review the document for applicability to your project.
2. Install and configure the required software in your project configuration management system, as cited in the Tool Operational Requirements document.
3. Locate and make a copy of the `.docx` Tool Operational Requirements document template file for the tool.
4. Edit the template, as required for your application, and make the document available for review by certification authorities.

After you complete this procedure, verify that the tool satisfies Tool Operational Requirements, as described in “Verify That the Tool Satisfies Tool Operational Requirements” on page 2-7.

Verify That the Tool Satisfies Tool Operational Requirements

After you document the Tool Operational Requirements, verify that the tool satisfies the Tool Operational Requirements. The Test Cases, Procedures, and Results document provides the following information:

- Introduction
- Description of test cases and procedures
- Traceability matrix between operational requirements and test cases and procedures
- Procedure for executing the test cases and procedures
- Test results

To verify that the tool satisfies the Tool Operational Requirements, complete the following steps for each tool that you plan to qualify:

1. Locate the PDF version of the Test Cases, Procedures, and Results (TCPR) document provided for the tool in the DO Qualification Kit product, and review the test cases and procedures described in the document for applicability to your project.
2. Locate and make a copy of the `.docx` Test Cases, Procedures, and Results document template file for the tool.
3. Edit the test cases and procedures sections of the template, as required for your application, and finalize the document. For example, you might need to modify content in the Expected Result column of the table in the traceability matrix.
4. Locate and configure the test cases and procedures in your project configuration management system.
5. Execute the test cases and procedures in the installed and configured environment. For more information, see “Executing the Test Cases and Procedures” in the Test Cases, Procedures, and Results document for the verification tool you are qualifying.
6. Review the test results. If the results are not expected:
   - Verify that you correctly installed and are using the specified versions of all required MathWorks software.
   - Check whether known bug reports related to this product exist on the MathWorks Web site (`www.mathworks.com`).
   - Contact MathWorks support for assistance.
   - Document a limitation of the tool usage in your Tool Accomplishments Summary if you cannot resolve the test failure.

7 Configure the test results in your project configuration management system.

After you complete this procedure, document and provide the results to certification authorities, as described in “Provide Certification Authorities with Tool Qualification Results” on page 2-9.

Provide Certification Authorities with Tool Qualification Results

After you verify whether the tool satisfies tool operational requirements, complete the following steps for each tool that you are qualifying.

1. Document the test results in a Tool Accomplishment Summary.
2. Add an entry that summarizes the results of the tool qualification to the Software Accomplishment Summary (SAS). You can also submit the Tool Accomplishment Summary with the SAS.
3. Submit the SAS to the certification authorities so that they can approve the results. The data can provide a record of the qualification status of the tool.

3

Access and Manage Qualification Artifacts

- "Access Artifacts Using the Certification Artifacts Explorer" on page 3-2
- "Manage Artifacts Using the Certification Artifacts Explorer" on page 3-4
- "Delete Certification Packages from Certification Artifacts Explorer" on page 3-5
- "Certification Artifacts Explorer Limitations" on page 3-6
- "Certification Artifacts Explorer on Linux and Mac Platforms" on page 3-7

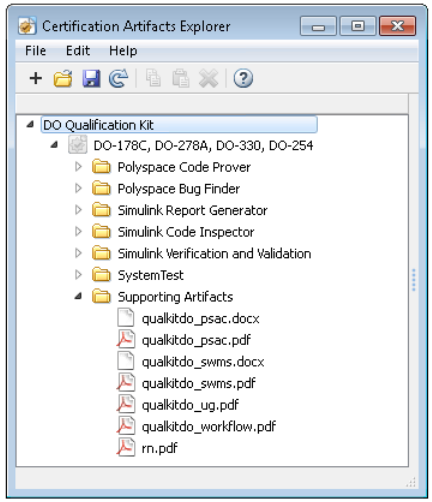
Access Artifacts Using the Certification Artifacts Explorer

You can use the Certification Artifacts Explorer to access qualification artifacts. To start the Certification Artifacts Explorer, use one of the following methods.

To start the Certification Artifacts Explorer...	Do this:
From the MATLAB Toolstrip	1 Install the **Certification Artifacts Explorer** app: • Click the **Apps** tab and select **Install App**. • Navigate to *matlabroot*`/toolbox/qualkits/do/` and open `Certification Artifacts Explorer.mlappinstall`. 2 Click the **Apps** tab and select **Certification Artifacts Explorer**.
From the MATLAB command line	Enter `qualkitdo`.

The Certification Artifacts Explorer window displays the qualification artifacts that are available with the DO Qualification Kit product. If the DO Qualification Kit product contains artifacts for more than one release, the window lists the artifacts for each release. As you select folders and files, relevant information about the current selection is dynamically displayed in the status bar.

- To display the properties of a certification package, right-click the package name and select **Properties**.
- To open an artifact, right-click the artifact and select **Open File**.
- Depending on the type or state of an artifact, other right-click actions might be available including **Copy**, **Paste**, **Delete**, **Open Folder**, and **Generate Traceability Matrix**.


Certification Artifacts Explorer
File
Edit
Help
DO Qualification Kit
DO-178C, DO-278A, DO-330, DO-254
Polyspace Code Prover
Polyspace Bug Finder
Simulink Report Generator
Simulink Code Inspector
Simulink Verification and Validation
SystemTest
Supporting Artifacts
qualkitdo_psac.docx
qualkitdo_psac.pdf
qualkitdo_swms.docx
qualkitdo_swms.pdf
qualkitdo_ug.pdf
qualkitdo_workflow.pdf
rn.pdf

Manage Artifacts Using the Certification Artifacts Explorer

To manage tool qualification artifacts using the Certification Artifacts Explorer:

1. Create a new certification package using one of the following methods:
   - Select the menu item **File > New**.
   - Click the toolbar icon **Create new certification package**.
   - Right-click an existing package and select **New**.
2. Name the new certification package.
3. Define the location where the Certification Artifacts Explorer stores the new certification package (use right-click **> Properties**).
4. Save the new certification package. The saved package has a KIT extension.
5. Copy the tool qualification artifacts for the product of interest and paste them into the new certification package:
   - To copy, select the artifacts of interest and use **Edit > Copy**.
   - To paste, select the new certification package and use **Edit > Paste**.

   To create top-level folders within the new certification package, use the copy and paste operations in the Certification Artifacts Explorer.
6. Delete qualification artifacts that are not required for your project.
7. Optionally, add related files to the certification package top-level folders using a file browser such as Microsoft® Windows® Explorer. When you add files, to refresh the file list, use **File > Refresh**.
8. Use the Certification Artifacts Explorer to access tool qualification artifacts.

When you create and save new certification packages, the Certification Artifacts Explorer displays them. The certification packages that are listed remain visible unless you delete them from the Certification Artifacts Explorer.

Delete Certification Packages from Certification Artifacts Explorer

The Certification Artifacts Explorer displays certification packages that you create or open. If you delete a certification package from the Certification Artifacts Explorer, the files associated with the package are still available on your computer. To delete the files, use a file browser such as Windows Explorer.

Certification Artifacts Explorer Limitations

The Certification Artifacts Explorer has the following limitation:

- For optimal performance, Microsoft Internet Explorer® must be available on your machine. Internet Explorer does not have to be your default web browser.

Certification Artifacts Explorer on Linux and Mac Platforms

You can use the Certification Artifacts Explorer to access qualification artifacts on Linux® and Mac platforms.

Platform	Artifacts of file type	Software that Certification Artifacts Explorer opens
Linux	`PDF` If you are not able to open or view the `PDF`, use Document Viewer to open the file.	Ghostview
	Microsoft Word `.doc`, `.docx` or `.rtf` When viewing the artifacts, if you encounter formatting issues: **1** Save the file as an OpenDocument Text (`.odt`) file, using Microsoft Word on a Windows platform. **2** Open the OpenDocument Text (`.odt`) version of the artifact, using OpenOffice on a Linux platform. Formatting issues can include problems with page breaks, tables, or line breaks.	OpenOffice
	Microsoft Excel® `.xls` or `.xlsx`	OpenOffice
	`HTML`	MATLAB Web browser
Mac	`PDF`	Preview Files opened with Preview are read only.
	Microsoft Word `.doc` or `.docx`	• Microsoft Word for Mac, if it is installed.

Platform	Artifacts of file type	Software that Certification Artifacts Explorer opens
		• TextEdit, if Microsoft Word for Mac is not installed.
	`.rtf`	TextEdit
	Microsoft Excel `.xls` or `.xlsx`	• Microsoft Excel for Mac, if it is installed. • Preview, if Microsoft Excel for Mac is not installed. Files opened with Preview are read only.
	`HTML`	MATLAB Web browser

4

Traceability Matrix Creation

- "Generate a Traceability Matrix" on page 4-2
- "Add Comments to a Traceability Matrix" on page 4-6
- "Traceability Matrix Limitations" on page 4-8

Generate a Traceability Matrix

In this section...
"About Traceability Matrices" on page 4-2
"Prerequisites for Generating a Traceability Matrix" on page 4-3
"Generate a Traceability Matrix" on page 4-3

About Traceability Matrices

When you use Model-Based Design and production code generation to develop application software components, you can generate a *traceability matrix*. The traceability matrix provides traceability among model objects, generated code, and model requirements. You can add comments to the generated traceability matrix. If you change the model and regenerate the traceability matrix, the software retains your comments.

For a given model, the generated traceability matrix can provide information about:

- Model objects that are traceable between the model and generated code, such as Simulink blocks, Stateflow® objects, and MATLAB functions.
- Model objects that are untraceable between the model and generated code, such as eliminated and virtual blocks.
- Requirements documents that you link to model objects using the Simulink Verification and Validation Requirements Management Interface (RMI).

Generate the traceability matrix using either the `do178c.ExportTraceReport` function from the MATLAB Command Window or the **Generate Traceability Matrix** button in the generated HTML code generation report for your model. Either method creates an XLS file that contains the following worksheets:

- **Model Information** — Summary of the model configuration and checksum. The summary includes the model name, version, author, creation date, last saved by, last updated date, checksum, and the selection of **Traceability Report Contents** parameters.
- **Code Interface** — Information about the generated code interface, such as function prototype and timing information for the model initialize and step functions.
- **Code Files** — File folders and names of the generated code files.
- **Report** — Traceability information for each model object, including model, generated code, and requirements. Each row in the worksheet pertains to a single occurrence

of a model object. The information for a model object is in more than one row if the object:

- Appears more than once in the generated code.
- Links to more than one requirement.

Prerequisites for Generating a Traceability Matrix

Before generating a traceability matrix for model objects, generated code, and model requirements, perform the following steps:

1. Optionally, attach requirements documents. For more information, see "Requirements Traceability" in the Simulink Verification and Validation documentation.
2. In the Configuration Parameters dialog box, on the **Code Generation > Report** pane, select:

   a. **"Create code generation report"**

   b. At least one of the following **Traceability Report Contents** parameters:

      - **"Eliminated / virtual blocks"**
      - **"Traceable Simulink blocks"**
      - **"Traceable Stateflow objects"**
      - **"Traceable MATLAB functions"**

   Tip If you want to generate the traceability matrix directly from the code generation report, select **"Open report automatically"**.

3. Generate code for the model.

Tip You do not have to build an executable to generate a traceability matrix. To generate code only, on the **Code Generation > General** pane, select **Generate code only**.

Generate a Traceability Matrix

To generate a traceability matrix:

1. Open the model if it is not already open.
2. Verify that you have completed the "Prerequisites for Generating a Traceability Matrix" on page 4-3.
3. Generate the traceability matrix using one of the following methods:

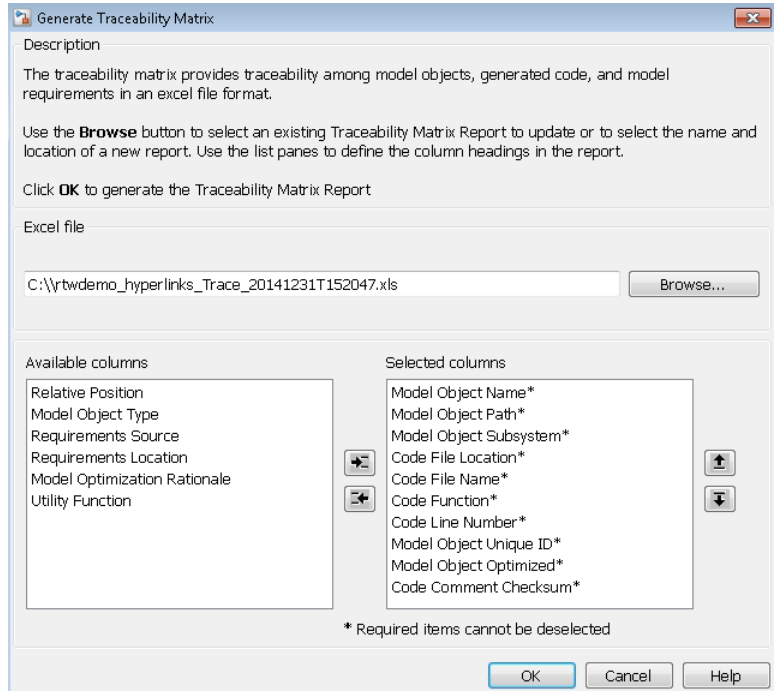
   - In the MATLAB Command Window, enter the following command, where *`model_name`* is the name of the model:

     ```
     do178c.ExportTraceReport('model_name')
     ```

     The software generates the traceability matrix.

   - Open the code generation report for the model if it is not already open. Go to the **Traceability Report** section and click the **Generate Traceability Matrix** button. For example:

     When you click the button, the Generate Traceability Matrix dialog box appears.


Generate Traceability Matrix
Description
The traceability matrix provides traceability among model objects, generated code, and model requirements in an excel file format.
Use the Browse button to select an existing Traceability Matrix Report to update or to select the name and location of a new report. Use the list panes to define the column headings in the report.
Click OK to generate the Traceability Matrix Report
Excel file
C:\\rtwdemo_hyperlinks_Trace_20141231T152047.xls
Browse...
Available columns
Relative Position
Model Object Type
Requirements Source
Requirements Location
Model Optimization Rationale
Utility Function
Selected columns
Model Object Name*
Model Object Path*
Model Object Subsystem*
Code File Location*
Code File Name*
Code Function*
Code Line Number*
Model Object Unique ID*
Model Object Optimized*
Code Comment Checksum*
* Required items cannot be deselected
OK
Cancel
Help

You can use this dialog box to browse to an existing matrix file to update or specify a new matrix file to create. Optionally, you can also use this dialog box to select and order the columns that appear in the generated matrix. Click **OK** to update or create the specified report.

4 Review the traceability matrix and add comments in new columns. For more information, see “Add Comments to a Traceability Matrix” on page 4-6.

Add Comments to a Traceability Matrix

In this section...
"Requirements for Adding Comments to a Traceability Matrix" on page 4-6 "Retain Comments" on page 4-7

Requirements for Adding Comments to a Traceability Matrix

You can add comments to the traceability matrix that you generated using the `do178c.ExportTraceReport` function.

To add comments to the traceability matrix, you must:

- Create new columns for your comments.
- Use unique column headings. Columns that you add must have headings.
- Add at least one entry to the column, other than the column heading.
- Retain the following columns:
  - Model Object Name
  - Model Object Path
  - Model Object Subsystem
  - Code File Location
  - Code File Name
  - Code Function
  - Code Line Number
  - Model Object Unique ID
  - Model Object Optimized
  - Code Comment Checksum

Note: All comments must resolve to a text string. For example, a link to an image resolves to a text string, but a copy of the image does not.

Retain Comments

To regenerate a traceability matrix and retain your comments:

1. Navigate to the working folder of the model.
2. Optionally, regenerate code for your model. Regenerating code before generating the traceability matrix ensures that you have the latest model-to-code traceability information.
3. In the MATLAB Command Window, enter the following command. *`file_name`* is the name of the existing traceability matrix that you are regenerating. If the existing traceability matrix is in a different folder, include the full path to that folder in *`path`*.

   ```
   do178c.ExportTraceReport('model_name', 'file_name', 'path')
   ```

   The traceability matrix regenerates.

Traceability Matrix Limitations

The traceability matrix generation capability has the following limitations:

- Works with the Microsoft Windows platform only.
- Does not support referenced models. When you generate a traceability matrix for a model that contains referenced models, the traceability matrix contains information about the Model block only. The traceability matrix does not contain information about the contents of the referenced model. If your model contains referenced models, generate a traceability matrix for the top-level model and each referenced model separately.
- Does not support models that use the model configuration option **Classic call interface** (`GRTInterface`).
- In most cases, identifies comments that you add to the traceability matrix, but when comments cannot be identified, the traceability matrix includes the text:
  Row is not unique: *`comment`*
- If a requirement is linked to an annotation not contained in a DocBlock block, the traceability matrix does not contain the requirement link. To generate a traceability report containing a requirement link to an annotation, put the annotation in a DocBlock block.

Functions — Alphabetical List

do178c.ExportTraceReport

Generate XLS file that contains traceability matrix

Syntax

```
do178c.ExportTraceReport('model_name')
do178c.ExportTraceReport('model_name', 'file_name')
do178c.ExportTraceReport('model_name', 'file_name', 'path')
```

Description

`do178c.ExportTraceReport('model_name')` generates an XLS file that contains a "Traceability Matrix" on page 5-3. *`model_name`* is the name of the model.

`do178c.ExportTraceReport('model_name', 'file_name')` generates an XLS file that contains a "Traceability Matrix" on page 5-3. *`file_name`* is a string that specifies the name of the file. The first time that you call `do178c.ExportTraceReport`, *`file_name`* is optional. If you do not provide *`file_name`*, the function names the file using the following convention. *`modelUpdate`* is the date and time that you last updated the model:
`model_name``_Trace_`*`modelUpdate`*`.xls`

To regenerate the traceability matrix, you must specify *`file_name`*.

`do178c.ExportTraceReport('model_name', 'file_name', 'path')` generates an XLS file that contains a "Traceability Matrix" on page 5-3. *`path`* is an optional string that specifies the full path to the location where you want the software to save the file.

Examples

Generate a traceability matrix with traceability between model objects and generated code for the `rtwdemo_hyperlinks` model:

Note: This example requires an Embedded Coder license.

```
% Open the model.
open_system('rtwdemo_hyperlinks');
% Generate code only.
set_param('rtwdemo_hyperlinks', 'GenCodeOnly', 'on');
% Initiate the build process.
rtwbuild('rtwdemo_hyperlinks');
% Generate a traceability matrix.
do178c.ExportTraceReport('rtwdemo_hyperlinks');
```

Generate a traceability matrix with traceability among model objects, generated code, and model requirements for the `slvnvdemo_fuelsys_docreq` model:

Note: This example requires a Simulink Verification and Validation license.

```
% Open the model.
open_system('slvnvdemo_fuelsys_docreq');
% Select the code generation report and traceability report parameters.
set_param('slvnvdemo_fuelsys_docreq', 'GenerateReport', 'on');
set_param('slvnvdemo_fuelsys_docreq', 'GenerateTraceReport', 'on');
set_param('slvnvdemo_fuelsys_docreq', 'GenerateTraceReportSl', 'on');
set_param('slvnvdemo_fuelsys_docreq', 'GenerateTraceReportSf', 'on');
set_param('slvnvdemo_fuelsys_docreq', 'GenerateTraceReportEml', 'on');
% Generate code only.
set_param('slvnvdemo_fuelsys_docreq', 'GenCodeOnly', 'on');
% Initiate the build process.
rtwbuild('slvnvdemo_fuelsys_docreq');
% Generate a traceability matrix.
do178c.ExportTraceReport('slvnvdemo_fuelsys_docreq');
```

Alternatives

You can generate a traceability matrix directly from the code generation report for your model. Go to the **Traceability Report** section and click the **Generate Traceability Matrix** button.

More About

Traceability Matrix

A traceability matrix provides traceability among model objects, generated code, and model requirements. You can add comments to the generated traceability matrix. If

you change the model and regenerate the traceability matrix, the software retains your comments.

Tips

- The `do178c.ExportTraceReport` function works on Microsoft Windows platforms only.
- To include requirements documentation in the traceability matrix, attach requirements documents to the model before using `do178c.ExportTraceReport`.
- You must generate a code generation traceability report (requires an Embedded Coder license) for your model before using `do178c.ExportTraceReport`.
- The `do178c.ExportTraceReport` function does not support referenced models. When you generate a traceability matrix for a model that contains referenced models, the traceability matrix contains information about the Model block only. The traceability matrix does not contain information about the contents of the referenced model. If your model contains referenced models, generate a traceability matrix for the top-level model and each referenced model separately.
- The `do178c.ExportTraceReport` function does not support models that use the model configuration option **Classic call interface** (`GRTInterface`).
- In most cases, the `do178c.ExportTraceReport` function identifies comments that you add to the traceability matrix. When the function cannot identify comments, the traceability matrix includes the text:
  Row is not unique: *`comment`*

For more information, see “Prerequisites for Generating a Traceability Matrix” on page 4-3.

- “Generate a Traceability Matrix” on page 4-2
- “Add Comments to a Traceability Matrix” on page 4-6
- “Code Tracing”

qualkitdo

Open Certification Artifacts Explorer for DO Qualification Kit

Syntax

```
qualkitdo
```

Description

`qualkitdo` opens the Certification Artifacts Explorer and displays qualification artifacts.

Alternatives

Open the Certification Artifact Explorer from the MATLAB Toolstrip:

1. Install the **Certification Artifacts Explorer** app:
   - Click the **Apps** tab and select **Install App**.
   - Navigate to *`matlabroot`*`/toolbox/qualkits/do/` and open `Certification Artifacts Explorer.mlappinstall`.
2. Click the **Apps** tab and select **Certification Artifacts Explorer**.

More About

Tips

- For optimal performance, Microsoft Internet Explorer should be available on your machine. Internet Explorer does not have to be your default web browser.

6

Model Advisor Checks

DO Qualification Kit Checks

In this section...
“Display bug reports using DO Qualification Kit checks” on page 6-3
“Display bug reports for Simulink Verification and Validation” on page 6-4
“Display bug reports for DO Qualification Kit” on page 6-5
“Display bug reports for Simulink Code Inspector” on page 6-6
“Display bug reports for Simulink Report Generator” on page 6-7
“Display bug reports for SystemTest” on page 6-8
“Display bug reports for Polyspace Bug Finder” on page 6-9
“Display bug reports for Polyspace Code Prover” on page 6-10
“Display bug reports for Embedded Coder” on page 6-11

Display bug reports using DO Qualification Kit checks

You can use the DO Qualification Kit Model Advisor checks to display bug reports for supported products.

Display bug reports for Simulink Verification and Validation

Display bug reports for the Simulink Verification and Validation R2015a product.

Description

Run this check to display the bug reports for Simulink Verification and Validation R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Simulink Verification and Validation R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

"Simulink Verification and Validation" documentation

Display bug reports for DO Qualification Kit

Display bug reports for the DO Qualification Kit R2015a product.

Description

Run this check to display the bug reports for DO Qualification Kit R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the DO Qualification Kit R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

"DO Qualification Kit (for DO-178)" documentation

Display bug reports for Simulink Code Inspector

Display bug reports for the Simulink Code Inspector R2015a product.

Description

Run this check to display the bug reports for Simulink Code Inspector R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Simulink Code Inspector R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

“Simulink Code Inspector” documentation

Display bug reports for Simulink Report Generator

Display bug reports for the Simulink Report Generator R2015a product.

Description

Run this check to display the bug reports for Simulink Report Generator R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Simulink Report Generator R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

“Simulink Report Generator” documentation

Display bug reports for SystemTest

Display bug reports for the SystemTest R2015a product.

Description

Run this check to display the bug reports for SystemTest R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the SystemTest R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

"SystemTest" documentation

Display bug reports for Polyspace Bug Finder

Display bug reports for the Polyspace Bug Finder R2015a product.

Description

Run this check to display the bug reports for Polyspace Bug Finder R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Polyspace Bug Finder R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

"Polyspace Bug Finder"

Display bug reports for Polyspace Code Prover

Display bug reports for the Polyspace Code Prover R2015a products.

Description

Run this check to display the bug reports for Polyspace Code Prover R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Polyspace Code Prover R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

"Polyspace Code Prover"

Display bug reports for Embedded Coder

Display bug reports for the Embedded Coder R2015a product.

Description

Run this check to display the bug reports for Embedded Coder R2015a that are available at www.mathworks.com/support/bugreports.

Note: This check does not determine whether your model might be affected by these bugs.

Available with the DO Qualification Kit.

Input Parameters

To display bug reports modified after a certain date, use the **Only show bug reports modified after date (mm/dd/yyyy)** field.

Results and Recommended Actions

Condition	Recommended Action
There are bug reports for the Embedded Coder R2015a product.	Review the bug report descriptions and workarounds provided in the links listed in the **ID** column of the Model Advisor window.

See Also

“Embedded Coder” documentation

References

Normative References

DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*. RTCA, Inc., 2011.

DO-330, *Software Tool Qualification Considerations*. RTCA, Inc., 2011.

DO-331, *Model-Based Development and Verification Supplement to DO-178C and DO-278A*. RTCA, Inc., 2011.

DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*. RTCA, Inc., 2000.

DO-278, *Guidelines for Communication, Navigation, Surveillance, and Air Traffic Management (CNA/ATM) Systems Software Integrity Assurance*. RTCA, Inc., 2002.

DO-278A, *Software Integrity Assurance Considerations for Communication, Navigation, Surveillance and Air Traffic Management (CNS/ATM) Systems*. RTCA, Inc., 2011.